

LISTING OF THE CLAIMS

This listing of claims is provided for the Examiner's convenience. No claims are amended herein.

1. (Previously Presented) A lens position detecting device for detecting the position of a lens on a base in an optical axis direction, the base being fixedly mounted in a lens barrel body, the device comprising:
 - a position detecting magnet mounted on either one of said lens and said base;
 - a magnetic force detecting sensor mounted on the other of said lens and said base, for generating a detected signal having a magnitude depending on the intensity of a magnetic force generated from magnetic poles of said position detecting magnet; and
 - positional information generating means for generating positional information of said lens on said base in said optical axis direction based on the magnitude of said detected signal.
2. (Original) The lens position detecting device according to claim 1, wherein said lens is held by a lens holder frame, said position detecting magnet is mounted on one of said lens holder frame and said base, and said magnetic force detecting sensor is mounted on the other of said lens holder frame and said base.

3. (Original) The lens position detecting device according to claim 2, further comprising a lens guide mechanism for holding said lens holding frame on said base for movement in said optical axis direction.

4. (Original) The lens position detecting device according to claim 1, wherein said position detecting magnet is magnetized in a direction parallel to said optical axis direction.

5. (Original) The lens position detecting device according to claim 1, wherein said magnetic force detecting sensor comprises a Hall device or a magnetoresistive device.

6. (Original) The lens position detecting device according to claim 1, wherein said magnetic force detecting sensor is disposed on a straight line passing through said position detecting magnet parallel to the optical axis of said lens.

7. (Original) The lens position detecting device according to claim 1, wherein said position detecting magnet is mounted on said lens holder frame, and said magnetic force detecting sensor is disposed on a straight line passing through said position detecting magnet parallel to the optical axis of said lens.

8. (Withdrawn) The lens position detecting device according to claim 1, wherein said positional information generating means has an amplifying circuit for amplifying said detected signal supplied from said magnetic force detecting sensor to generate an output signal, said positional information generating means generates said positional information based on said output signal, and said amplifying circuit is arranged to change an amplification factor to two or three or more different levels depending on the absolute value of the gradient of said output signal.

9. (Withdrawn) The lens position detecting device according to claim 8, further comprising noise removing means for removing noise of said detected signal or noise of said output signal.

10. (Original) The lens position detecting device according to claim 2, wherein said position detecting magnet is mounted on said lens holder frame, and said magnetic force detecting sensor comprises a first magnetic force detecting sensor and a second magnetic force detecting sensor and is mounted on said base.

11. (Original) The lens position detecting device according to claim 10, wherein said first magnetic force detecting sensor and said second magnetic force detecting sensor are disposed in respective two locations one on each side of said position detecting magnet, on a straight line passing through said position detecting magnet parallel to said optical axis.

12. (Original) The lens position detecting device according to claim 10, wherein said positional information generating means generates said positional information based on either one of a first detected signal supplied from said first magnetic force detecting sensor and a second detected signal supplied from said second magnetic force detecting sensor.

13. (Withdrawn) A lens barrel comprising:
a barrel;
a base disposed in said barrel;
an image capturing unit disposed in said barrel and mounted on said base;
a lens disposed in said barrel for guiding a subject image to said image capturing unit;
a lens holder frame disposed in said barrel and holding said lens;
a guide mechanism disposed in said barrel and supporting said lens holder frame for movement in an optical axis direction of said lens;
an actuating mechanism disposed in said barrel for moving said lens holder frame in said optical axis direction; and
a position detecting mechanism disposed in said barrel for detecting the position of said lens in said optical axis direction;
wherein said actuating mechanism has a coil mounted on one of said base and said lens holder frame, an actuating magnet mounted on the other of said base and said lens holder frame, and current supply means for supplying a drive current to said coil;

said actuating magnet having a magnetic pole surface extending parallel to the optical axis of said lens;

said magnetic pole surface having two different magnetic poles arrayed in a direction in which said magnetic pole surface extends;

said coil having a winding disposed around an axis perpendicular to said magnetic pole surface and having a winding end surface facing said magnetic pole surface;

wherein said position detecting mechanism comprises a position detecting magnet for generating a magnetic force and a magnetic force detecting sensor for detecting the magnetic force from said position detecting magnet through a magnetosensitive surface and generating a detected signal having a magnitude depending on the intensity of the magnetic force;

said position detecting magnet being mounted on said lens holder frame;

said base having a thin wall portion in a wall portion through which a straight line extending through said position detecting magnet parallel to said optical axis passes;
and

said magnetic force detecting sensor being disposed in place with said magnetosensitive surface being held against said thin wall portion by a metal plate mounted on said base and made of a weak magnetic material, said metal plate being pressed against a rear surface of said magnetic force detecting sensor which is opposite to said magnetosensitive surface.

14. (Withdrawn) The lens barrel according to claim 13, wherein said position detecting magnet has a portion facing said image capturing unit side in said optical axis direction and magnetized into one of an N pole and an S pole, and a portion facing said subject side in said optical axis direction and magnetized into the other of the N pole and the S pole.

15. (Withdrawn) The lens barrel according to claim 13, wherein said lens comprises a focus adjusting lens movable in said optical axis direction for adjusting the focal point of the subject image which is focused onto said image capturing unit.

16. (Withdrawn) The lens barrel according to claim 13, wherein said base has a recess defined in said wall portion through which the straight line extending through said position detecting magnet parallel to said optical axis passes, said recess being open in a direction away from said position detecting magnet, said magnetic force detecting sensor being disposed in said recess, said thin wall portion comprising a bottom wall of said recess.

17. (Withdrawn) The lens barrel according to claim 16, wherein said recess is defined by a through hole extending through the wall portion of said base through which the straight line extending through said position detecting magnet parallel to said optical axis passes, and a thin plate of a nonmagnetic material which is disposed in said through hole to close the through hole near said position detecting magnet, said thin wall portion comprising said thin plate.

18. (Withdrawn) The lens barrel according to claim 13, wherein said actuating magnet is disposed such that a hypothetical line perpendicular to said optical axis crosses said magnetic pole surface at a right angle.

19. (Withdrawn) The lens barrel according to claim 13, wherein said coil is mounted on said lens holder frame, and said actuating magnet is mounted on said base.

20. (Withdrawn) The lens barrel according to claim 13, wherein said actuating magnet is of a rectangular shape which is elongate in the optical axis direction of said lens.

21. (Withdrawn) The lens barrel according to claim 13, wherein said actuating magnet comprises a flat magnet of a rectangular shape having a length extending in the optical axis direction of said lens, a width smaller than said length, and a height smaller than said width, said flat magnet being elongate in the optical axis direction of said lens and having a small thickness, said magnetic pole surface comprises an elongate rectangular surface of said flat magnet having said length and said width.

22. (Withdrawn) The lens barrel according to claim 13, wherein said coil comprises a flat coil having a winding having a winding end surface, and a winding height smaller than the size of the contour of said winding end surface and a small height in a direction perpendicular to said magnetic pole surface.

23. (Withdrawn) The lens barrel according to claim 13, wherein said coil comprises a flat coil having a winding shaped as a rectangular frame, and having a winding height smaller than longer sides and shorter sides of said rectangular frame, and a small height in a direction perpendicular to said magnetic pole surface.

24. (Withdrawn) The lens barrel according to claim 13, wherein said lens is of a rectangular shape as viewed from said optical axis direction, and said actuating magnet is disposed such that said magnetic pole surface lies parallel to one side of said rectangular lens as viewed from said optical axis direction.

25. (Withdrawn) The lens barrel according to claim 13, wherein said guide mechanism has a guide shaft extending parallel to said optical axis, said actuating magnet being mounted on said base, further comprising a guide shaft holder supporting said guide shaft and a magnet holder supporting said actuating magnet, said guide shaft holder and said magnet holder being integrally formed with said base.

26. (Withdrawn) An image capturing device having a lens barrel having an image capturing unit for capturing a subject image guided by a lens, said lens barrel comprising:

- a barrel;
- a base disposed in said barrel, said image capturing unit being mounted on said base;
- said lens disposed in said barrel;

a lens holder frame disposed in said barrel and holding said lens;

a guide mechanism disposed in said barrel and supporting said lens holder frame for movement in an optical axis direction of said lens; and

an actuating mechanism disposed in said barrel for moving said lens holder frame in said optical axis direction;

wherein said actuating mechanism has a coil mounted on one of said base and said lens holder frame, an actuating magnet mounted on the other of said base and said lens holder frame, and current supply means for supplying a drive current to said coil;

said actuating magnet having a magnetic pole surface extending parallel to the optical axis of said lens;

said magnetic pole surface having two different magnetic poles arrayed in a direction in which said magnetic pole surface extends;

said coil having a winding disposed around an axis perpendicular to said magnetic pole surface and having a winding end surface facing said magnetic pole surface;

wherein said position detecting mechanism comprises a position detecting magnet for generating a magnetic force and a magnetic force detecting sensor for detecting the magnetic force from said position detecting magnet through a magnetosensitive surface and generating a detected signal having a magnitude depending on the intensity of the magnetic force;

said position detecting magnet being mounted on said lens holder frame;

said base having a thin wall portion in a wall portion through which a straight line extending through said position detecting magnet parallel to said optical axis passes; and

said magnetic force detecting sensor being disposed in place with said magnetosensitive surface being held against said thin wall portion by a metal plate mounted on said base and made of a weak magnetic material, said metal plate being pressed against a rear surface of said magnetic force detecting sensor which is opposite to said magnetosensitive surface.

27. (Withdrawn) A lens barrel comprising:

- a barrel;
- a base disposed in said barrel;
- an image capturing unit disposed in said barrel and mounted on said base;
- a lens disposed in said barrel for guiding a subject image to said image capturing unit;
- a lens holder frame disposed in said barrel and holding said lens;
- a guide mechanism disposed in said barrel and supporting said lens holder frame for movement in an optical axis direction of said lens;
- an actuating mechanism disposed in said barrel for moving said lens holder frame in said optical axis direction; and
- a position detecting mechanism disposed in said barrel for detecting the position of said lens in said optical axis direction;

wherein said actuating mechanism has a coil mounted on said lens holder frame, an actuating magnet mounted on said base, and current supply means for supplying a drive current to said coil;

said actuating magnet having a magnetic pole surface extending parallel to the optical axis of said lens;

said magnetic pole surface having two different magnetic poles arrayed in a direction in which said magnetic pole surface extends;

said coil having a winding disposed around an axis perpendicular to said magnetic pole surface and having a winding end surface facing said magnetic pole surface;

wherein said position detecting mechanism comprises a position detecting magnet for generating a magnetic force and a magnetic force detecting sensor for detecting the magnetic force from said position detecting magnet through a magnetosensitive surface and generating a detected signal having a magnitude depending on the intensity of the magnetic force;

said position detecting magnet being mounted on said lens holder frame;

said magnetic force detecting sensor being mounted on a wall portion of said base through which a straight line extending parallel to said optical axis through said position detecting magnet passes, with said magnetosensitive surface facing said position detecting magnet; and

wherein said actuating magnet generates a first flux line and said position detecting magnet generates a second flux line, said first flux line and said second flux

line being oriented in the same direction at a magnetic interference point where said first flux line and said second flux line cross each other.

28. (Withdrawn) The lens barrel according to claim 27, wherein the magnetic pole surface of said actuating magnet has a portion closer to said image capturing unit in said optical axis direction and magnetized into one of an N pole and an S pole, and a portion closer to said subject in said optical axis direction and magnetized into the other of the N pole and the S pole, and said position detecting magnet has a portion facing said image capturing unit in said optical axis direction and magnetized into one of an N pole and an S pole, and a portion facing said subject in said optical axis direction and magnetized into the other of the N pole and the S pole.

29. (Withdrawn) The lens barrel according to claim 27, wherein the center of a magnetic field generated by said actuating magnet and the center of a magnetic field generated by said position detecting magnet are spaced from each other in a direction parallel to said optical axis.

30. (Withdrawn) The lens barrel according to claim 27, wherein said lens comprises a focus adjusting lens movable in said optical axis direction for adjusting the focal point of the subject image which is focused onto said image capturing unit.

31. (Withdrawn) The lens barrel according to claim 27, wherein said actuating magnet is disposed such that a hypothetical line perpendicular to said optical axis crosses said magnetic pole surface at a right angle.

32. (Withdrawn) The lens barrel according to claim 27, wherein said actuating magnet is of a rectangular shape which is elongate in the optical axis direction of said lens.

33. (Withdrawn) The lens barrel according to claim 27, wherein said actuating magnet comprises a flat magnet of a rectangular shape having a length extending in the optical axis direction of said lens, a width smaller than said length, and a height smaller than said width, said flat magnet being elongate in the optical axis direction of said lens and having a small thickness, said magnetic pole surface comprises an elongate rectangular surface of said flat magnet having said length and said width.

34. (Withdrawn) The lens barrel according to claim 27, wherein said coil comprises a flat coil having a winding having a winding end surface, and a winding height smaller than the size of the contour of said winding end surface and a small height in a direction perpendicular to said magnetic pole surface.

35. (Withdrawn) The lens barrel according to claim 27, wherein said coil comprises a flat coil having a winding shaped as a rectangular frame, and having a

winding height smaller than longer sides and shorter sides of said rectangular frame, and a small height in a direction perpendicular to said magnetic pole surface.

36. (Withdrawn) The lens barrel according to claim 27, wherein said lens is of a rectangular shape as viewed from said optical axis direction, and said actuating magnet is disposed such that said magnetic pole surface lies parallel to one side of said rectangular lens as viewed from said optical axis direction.

37. (Withdrawn) The lens barrel according to claim 27, wherein said guide mechanism has a guide shaft extending parallel to said optical axis, said actuating magnet being mounted on said base, further comprising a guide shaft holder supporting said guide shaft and a magnet holder supporting said actuating magnet, said guide shaft holder and said magnet holder being integrally formed with said base.

38. (Withdrawn) An image capturing device having a lens barrel having an image capturing unit for capturing a subject image guided by a lens, said lens barrel comprising:

a barrel;

a base disposed in said barrel, said image capturing unit being mounted on said base;

said lens disposed in said barrel;

a lens holder frame disposed in said barrel and holding said lens;

a guide mechanism disposed in said barrel and supporting said lens holder frame for movement in an optical axis direction of said lens; and

an actuating mechanism disposed in said barrel for moving said lens holder frame in said optical axis direction;

wherein said actuating mechanism has a coil mounted on said lens holder frame, an actuating magnet mounted on said base, and current supply means for supplying a drive current to said coil;

said actuating magnet having a magnetic pole surface extending parallel to the optical axis of said lens;

said magnetic pole surface having two different magnetic poles arrayed in a direction in which said magnetic pole surface extends;

said coil having a winding disposed around an axis perpendicular to said magnetic pole surface and having a winding end surface facing said magnetic pole surface;

wherein said position detecting mechanism comprises a position detecting magnet for generating a magnetic force and a magnetic force detecting sensor for detecting the magnetic force from said position detecting magnet through a magnetosensitive surface and generating a detected signal having a magnitude depending on the intensity of the magnetic force;

said position detecting magnet being mounted on said lens holder frame;

said magnetic force detecting sensor being mounted on a wall portion of said base through which a straight line extending parallel to said optical axis through said

position detecting magnet passes, with said magnetosensitive surface facing said position detecting magnet; and

wherein said actuating magnet generates a first flux line and said position detecting magnet generates a second flux line, said first flux line and said second flux line being oriented in the same direction at a magnetic interference point where said first flux line and said second flux line cross each other.